

Vertical distribution and temporal changes of ^{137}Cs in soil profiles under various land uses after the Fukushima Dai-ichi Nuclear Power Plant accident

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Table. Dry weight of soil sample collected by scraper plate (15×30cm), mass depth, ¹³⁷Cs concentration and ¹³⁷Cs inventory and distribution ratios of ¹³⁷Cs in litter and soil samples (0–10cm) under various land uses.
The first, second, third, and fourth survey periods were June – Aug. 2011, Dec. 2011 – Jan. 2012, Aug. – Sep. 2012 and Dec. 2012, respectively.

site	Depth(cm)	Dry weight of soil sample ^a (g)				Mass depth ^b (g cm ⁻²)				¹³⁷ Cs concentration ^c (Bq kg ⁻¹)								¹³⁷ Cs inventory ^e (Bq m ⁻²)							
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	±error ^d	2nd	±error ^d	3rd	±error ^d	4th	±error ^d	1st	%	2nd	%	3rd	%	4th	%
Mixed forest (MF)	litter	126	91	85	44					1.3.E+05	2.4.E+03	1.4.E+05	7.6.E+03	9.1.E+04	3.8.E+03	1.6.E+05	1.6.E+05	3.5.E+05	90.6	2.9.E+05	65.3	1.7.E+05	55.7	1.5.E+05	41.2
	0–0.5	33	12	33	41	0.07	0.03	0.07	0.09	7.4.E+03	6.3.E+02	3.6.E+04	2.6.E+03	4.8.E+04	2.3.E+03	7.8.E+04	7.8.E+04	5.4.E+03	1.4	9.3.E+03	2.1	3.5.E+04	11.5	7.2.E+04	19.1
	0.5–1.0	32	14	49	32	0.14	0.06	0.18	0.16	6.3.E+03	5.5.E+02	2.1.E+04	1.4.E+03	2.3.E+04	1.2.E+03	6.6.E+04	6.6.E+04	4.5.E+03	1.2	6.3.E+03	1.4	2.5.E+04	8.1	4.7.E+04	12.5
	1.0–1.5	41	20	31	51	0.24	0.10	0.25	0.28	4.2.E+03	3.9.E+02	2.4.E+04	1.7.E+03	1.5.E+04	7.3.E+02	4.3.E+04	4.3.E+04	3.9.E+03	1.0	1.1.E+04	2.4	1.0.E+04	3.3	4.9.E+04	13.1
	1.5–2.0	59	40	50	72	0.37	0.19	0.36	0.44	3.0.E+03	3.0.E+02	1.5.E+04	1.1.E+03	1.0.E+04	5.3.E+02	1.7.E+04	1.7.E+04	3.9.E+03	1.0	1.3.E+04	2.9	1.1.E+04	3.7	2.8.E+04	7.3
	2.0–2.5	76	34	31	91	0.54	0.26	0.43	0.64	4.1.E+03	4.2.E+02	1.2.E+04	8.6.E+02	1.3.E+04	5.4.E+02	3.6.E+03	3.6.E+03	6.9.E+03	1.8	9.0.E+03	2.0	9.1.E+03	2.9	7.2.E+03	1.9
	2.5–3.0	75	45	46	74	0.70	0.36	0.53	0.80	2.1.E+03	2.0.E+02	1.5.E+04	9.5.E+02	5.2.E+03	3.1.E+02	1.5.E+03	1.5.E+03	3.5.E+03	0.9	1.5.E+04	3.3	5.4.E+03	1.7	2.4.E+03	0.6
	3.0–3.5	94	60	69	71	0.91	0.50	0.69	0.96	1.1.E+03	1.1.E+02	8.0.E+03	5.5.E+02	3.7.E+03	2.2.E+02	1.3.E+03	1.3.E+03	2.3.E+03	0.6	1.1.E+04	2.4	5.7.E+03	1.9	2.1.E+03	0.5
	3.5–4.0	88	55	89	93	1.11	0.62	0.88	1.17	6.2.E+02	7.8.E+01	7.3.E+03	4.2.E+02	2.3.E+03	1.1.E+02	6.6.E+02	6.6.E+02	1.2.E+03	0.3	8.9.E+03	2.0	4.5.E+03	1.5	1.4.E+03	0.4
	4.0–4.5	85	79	71	63	1.30	0.79	1.04	1.31	7.1.E+02	8.4.E+01	6.1.E+03	4.3.E+02	2.5.E+03	1.1.E+02	7.7.E+02	7.7.E+02	1.3.E+03	0.3	1.1.E+04	2.4	4.0.E+03	1.3	1.1.E+03	0.3
	4.5–5.0	98	85	62	84	1.51	0.98	1.18	1.49	3.9.E+02	4.5.E+01	4.1.E+03	2.9.E+02	1.9.E+03	1.3.E+02	6.7.E+02	6.7.E+02	8.4.E+02	0.2	7.7.E+03	1.7	2.6.E+03	0.8	1.3.E+03	0.3
	5.0–6.0	181	145	162	151	1.92	1.31	1.54	1.83	2.0.E+02	3.3.E+01	4.5.E+03	2.8.E+02	1.5.E+03	8.3.E+01	5.5.E+02	5.5.E+02	8.2.E+02	0.2	1.5.E+04	3.3	5.4.E+03	1.7	1.8.E+03	0.5
	6.0–7.0	244	166	245	63	2.46	1.68	2.09	1.97	1.1.E+02	1.8.E+01	2.8.E+03	2.0.E+02	8.4.E+02	5.0.E+01	8.5.E+02	8.5.E+02	6.1.E+02	0.2	1.0.E+04	2.3	4.6.E+03	1.5	1.2.E+03	0.3
	7.0–8.0	285	193	227	121	3.09	2.11	2.59	2.24	6.3.E+01	1.4.E+01	2.2.E+03	1.7.E+02	6.3.E+02	3.8.E+01	5.7.E+02	5.7.E+02	4.0.E+02	0.1	9.7.E+03	2.2	3.2.E+03	1.0	1.5.E+03	0.4
	8.0–9.0	309	218	241	282	3.78	2.59	3.13	2.86	6.8.E+01	1.3.E+01	2.2.E+03	1.6.E+02	8.7.E+02	2.8.E+01	4.1.E+02	4.1.E+02	4.7.E+02	0.1	1.1.E+04	2.4	4.7.E+03	1.5	2.6.E+03	0.7
	9.0–10.0	281	195	273	125	4.41	3.03	3.74	3.14	6.4.E+01	1.3.E+01	1.9.E+03	1.2.E+02	9.0.E+02	3.3.E+01	1.1.E+03	1.1.E+03	4.0.E+02	0.1	8.4.E+03	1.9	5.5.E+03	1.8	3.1.E+03	0.8
Total	2107	1450	1764	1457													3.9.E+05	100	4.5.E+05	100	3.1.E+05	100	3.8.E+05	100	
Total (without litter)	1981	1359	1678	1413																					
Mature cedar (MC)	litter	100	53	60	109					1.0.E+05	4.9.E+03	1.2.E+05	5.1.E+03	1.1.E+05	2.0.E+03	7.1.E+04	2.7.E+03	2.3.E+05	47.8	1.5.E+05	48.1	1.4.E+05	22.6	1.7.E+05	42.3
	0–0.5	63	24	84	40	0.14	0.05	0.19	0.09	1.6.E+04	1.5.E+03	1.0.E+05	3.0.E+03	1.1.E+05	4.4.E+03	5.4.E+04	1.6.E+03	2.2.E+04	4.5	5.4.E+04	17.7	2.1.E+05	34.0	4.8.E+04	11.7
	0.5–1.0	60	21	70	86	0.27	0.10	0.34	0.28	2.4.E+04	1.8.E+03	4.2.E+04	1.4.E+03	4.8.E+04	1.9.E+03	2.7.E+04	1.2.E+03	3.2.E+04	6.5	1.9.E+04	6.4	7.4.E+04	11.8	5.1.E+04	12.6
	1.0–1.5	189	26	82	71	0.69	0.16	0.53	0.44	2.0.E+04	1.7.E+03	3.0.E+04	8.2.E+02	2.6.E+04	1.2.E+03	1.9.E+04	8.8.E+02	8.6.E+04	17.5	1.8.E+04	5.8	4.8.E+04	7.7	3.0.E+04	7.4
	1.5–2.0	210	19	77	70	1.16	0.20	0.70	0.59	1.3.E+04	1.1.E+03	2.8.E+04	1.0.E+03	1.2.E+04	5.1.E+02	1.1.E+04	5.9.E+02	6.1.E+04	12.4	1.1.E+04	3.8	2.1.E+04	3.4	1.7.E+04	4.3
	2.0–2.5	132	27	98	68	1.46	0.26	0.92	0.74	7.4.E+03	6.2.E+02	2.3.E+04	1.2.E+03	9.7.E+03	4.5.E+02	7.6.E+03	3.7.E+02	2.2.E+04	4.4	1.4.E+04	4.5	2.1.E+04	3.4	1.1.E+04	2.8
	2.5–3.0	137	31	104	100	1.76	0.33	1.15	0.97	3.3.E+03	3.4.E+02	1.4.E+04	6.5.E+02	5.7.E+03	3.2.E+02	4.6.E+03	2.7.E+02	1.0.E+04	2.0	9.7.E+03	3.2	1.3.E+04	2.1	1.0.E+04	2.5
	3.0–3.5	143	30	88	114	2.08	0.39	1.34	1.22	2.1.E+03	1.6.E+02	9.6.E+03	3.4.E+02	7.7.E+03	3.6.E+02	1.1.E+03	8.1.E+01	6.8.E+03	1.4	6.3.E+03	2.1	1.5.E+04	2.4	2.8.E+03	0.7
	3.5–4.0	254	34	149	127	2.65	0.47	1.68	1.50	1.1.E+03	1.2.E+02	1.1.E+04	5.5.E+02	3.8.E+03	2.2.E+02	2.2.E+03	1.1.E+02	6.0.E+03	1.2	8.4.E+03	2.8	1.3.E+04	2.0	6.1.E+03	1.5
	4.0–4.5	181	40	135	142	3.05	0.56	1.98	1.82	8.2.E+02	5.1.E+01	4.9.E+03	3.0.E+02	4.1.E+03	1.5.E+02	1.9.E+03	1.3.E+02	3.3.E+03	0.7	4.4.E+03	1.5	1.2.E+04	2.0	6.1.E+03	1.5
	4.5–5.0	135	47	155	100	3.35	0.66	2.32	2.04	2.8.E+02	3.4.E+01	3.8.E+03	2.5.E+02	2.7.E+03	1.2.E+02	1.5.E+03	8.6.E+01	8.3.E+02	0.2	4.0.E+03	1.3	9.4.E+03	1.5	3.2.E+03	0.8
	5.0–6.0																								

		Total	5031	4844	4258	4130											1.0.E+06	100	1.2.E+06	100	8.8.E+05	100	1.1.E+06	100		
		Total (without litter)	4968	4828	4202	4057																				
Meadow land (ML)	litter	98	19	29	40					1.4.E+05	4.3.E+03	2.0.E+05	9.3.E+03	5.9.E+04	3.2.E+03	1.2.E+05	2.6.E+03	3.0.E+05	68.9	8.3.E+04	14.1	3.8.E+04	9.7	1.1.E+05	19.6	
	0-0.5	19	13	11	13	0.04	0.03	0.02	0.03	7.6.E+04	1.2.E+03	4.4.E+05	9.9.E+03	3.6.E+05	1.0.E+04	3.2.E+05	4.7.E+03	3.2.E+04	7.5	1.3.E+05	21.5	8.4.E+04	21.4	9.0.E+04	16.8	
	0.5-1.0	76	23	29	18	0.21	0.08	0.09	0.07	2.0.E+04	4.7.E+02	2.9.E+05	7.9.E+03	6.5.E+04	2.1.E+03	2.8.E+05	7.2.E+03	3.3.E+04	7.6	1.4.E+05	24.4	4.2.E+04	10.6	1.1.E+05	21.0	
	1.0-1.5	235	116	13	38	0.73	0.34	0.12	0.15	8.9.E+03	2.8.E+02	6.2.E+04	2.1.E+03	1.1.E+05	3.0.E+03	1.3.E+05	1.5.E+03	4.7.E+04	10.8	1.6.E+05	27.1	3.3.E+04	8.4	1.1.E+05	20.4	
	1.5-2.0	254	81	104	62	1.30	0.52	0.35	0.29	1.8.E+03	1.2.E+02	1.3.E+04	6.9.E+02	4.7.E+04	1.2.E+03	4.4.E+04	1.7.E+03	1.0.E+04	2.4	2.3.E+04	4.0	1.1.E+05	28.0	6.1.E+04	11.3	
	2.0-2.5	248	156	123	135	1.85	0.87	0.62	0.59	1.0.E+03	8.4.E+01	5.8.E+03	3.1.E+02	1.2.E+04	5.4.E+02	1.1.E+04	5.9.E+02	5.7.E+03	1.3	2.0.E+04	3.4	3.2.E+04	8.2	3.4.E+04	6.3	
	2.5-3.0	297	251	230	152	2.51	1.42	1.14	0.93	4.9.E+02	5.8.E+01	2.6.E+03	1.1.E+02	3.4.E+03	1.8.E+02	2.4.E+03	1.4.E+02	3.3.E+03	0.8	1.4.E+04	2.4	1.7.E+04	4.4	8.3.E+03	1.5	
	3.0-3.5	285	237	208	259	3.15	1.95	1.60	1.51	1.9.E+02	3.6.E+01	1.0.E+03	6.3.E+01	2.3.E+03	1.3.E+02	1.2.E+03	5.9.E+01	1.2.E+03	0.3	5.4.E+03	0.9	1.1.E+04	2.8	6.7.E+03	1.2	
	3.5-4.0	410	215	222	150	4.06	2.43	2.09	1.84	1.3.E+02	3.0.E+01	7.1.E+02	4.9.E+01	9.8.E+02	6.2.E+01	7.3.E+02	3.7.E+01	1.2.E+03	0.3	3.4.E+03	0.6	4.8.E+03	1.2	2.5.E+03	0.5	
	4.0-4.5	195	421	325	207	4.49	3.37	2.82	2.30	n.d.		3.0.E+02	1.7.E+01	4.2.E+02	2.8.E+01	4.4.E+02	3.2.E+01	n.d.		2.8.E+03	0.5	3.0.E+03	0.8	2.0.E+03	0.4	
	4.5-5.0	266	425	337	235	5.09	4.31	3.57	2.83	9.9.E+01	2.8.E+01	1.8.E+02	1.3.E+01	3.9.E+02	3.0.E+01	2.0.E+02	1.5.E+01	5.9.E+02	0.1	1.7.E+03	0.3	2.9.E+03	0.7	1.1.E+03	0.2	
	5.0-6.0	687	615	587	290	6.61	5.68	4.87	3.47	n.d.		1.3.E+02	9.8.E+00	2.5.E+02	1.5.E+01	1.8.E+02	7.1.E+00	n.d.		1.7.E+03	0.3	3.2.E+03	0.8	1.1.E+03	0.2	
	6.0-7.0	581	711	770	485	7.91	7.26	6.59	4.55	n.d.		8.6.E+01	6.9.E+00	1.5.E+02	1.1.E+01	1.2.E+02	7.1.E+00	n.d.		1.4.E+03	0.2	2.6.E+03	0.6	1.3.E+03	0.2	
	7.0-8.0	384	1240	894	618	8.76	10.03	8.58	5.93	n.d.		3.9.E+01	4.9.E+00	3.8.E+02	2.3.E+01	7.1.E+01	1.8.E+00	n.d.		1.1.E+03	0.2	7.5.E+03	1.9	9.8.E+02	0.2	
	8.0-9.0	268	353	513	564	9.36	10.81	9.72	7.18	n.d.		6.8.E+01	5.9.E+00	6.5.E+01	5.2.E+00	7.3.E+01	6.4.E+00	n.d.		5.3.E+02	0.1	7.4.E+02	0.2	9.1.E+02	0.2	
	9.0-10.0	238	449	699	552	9.89	11.81	11.27	8.41	n.d.		3.3.E+01	4.7.E+00	5.1.E+01	4.0.E+00	3.5.E+01	2.4.E+00	n.d.		3.3.E+02	0.1	7.9.E+02	0.2	4.3.E+02	0.1	
	Total	4541	5324	5094	3817															4.3.E+05	100	5.9.E+05	100	3.9.E+05	100	5.4.E+05
Total (without litter)	4443	5305	5065	3777																						
Farm land (FL)	litter	84	14	81	69					1.4.E+05	7.4.E+03	2.5.E+04	1.7.E+03	1.3.E+05	1.1.E+03	1.8.E+04	8.8.E+02	2.7.E+05	45.8	8.0.E+03	1.7	2.3.E+05	38.6	2.8.E+04	8.5	
	0-0.5	459	23	56	108	1.02	0.05	0.12	0.24	2.1.E+04	1.5.E+03	3.6.E+04	1.8.E+03	2.8.E+04	1.3.E+03	3.1.E+04	1.2.E+03	2.2.E+05	37.0	1.8.E+04	3.8	3.4.E+04	5.9	7.4.E+04	22.6	
	0.5-1.0	347	47	143	187	1.79	0.15	0.44	0.66	8.1.E+03	6.6.E+02	4.0.E+04	1.8.E+03	2.4.E+04	8.7.E+02	2.1.E+04	8.1.E+02	6.2.E+04	10.6	4.1.E+04	8.5	7.8.E+04	13.4	8.9.E+04	27.3	
	1.0-1.5	325	197	110	231	2.52	0.59	0.69	1.17	2.5.E+03	2.0.E+02	3.5.E+04	1.5.E+03	2.2.E+04	9.4.E+02	8.4.E+03	3.4.E+02	1.8.E+04	3.1	1.5.E+05	31.7	5.4.E+04	9.2	4.3.E+04	13.1	
	1.5-2.0	324	185	161	231	3.24	1.00	1.05	1.69	1.1.E+03	9.4.E+01	3.2.E+04	1.6.E+03	1.3.E+04	4.6.E+02	4.5.E+03	2.1.E+02	8.0.E+03	1.4	1.3.E+05	27.4	4.5.E+04	7.7	2.3.E+04	7.1	
	2.0-2.5	296	191	291	124	3.90	1.43	1.70	1.96	5.7.E+02	6.0.E+01	1.4.E+04	7.4.E+02	9.6.E+03	4.5.E+02	3.0.E+03	1.7.E+02	3.8.E+03	0.6	6.0.E+04	12.5	6.2.E+04	10.7	8.4.E+03	2.6	
	2.5-3.0	357	238	368	202	4.69	1.96	2.52	2.41	3.8.E+02	3.6.E+01	5.3.E+03	3.1.E+02	5.0.E+03	2.4.E+02	3.0.E+03	1.8.E+02	3.0.E+03	0.5	2.8.E+04	5.8	4.1.E+04	6.9	1.4.E+04	4.1	
	3.0-3.5	394	311	309	240	5.57	2.65	3.20	2.95	1.2.E+02	1.6.E+01	2.2.E+03	1.5.E+02	1.8.E+03	8.7.E+01	1.6.E+03	9.7.E+01	1.0.E+03	0.2	1.5.E+04	3.2	1.3.E+04	2.2	8.4.E+03	2.6	
	3.5-4.0	276	229	282	367	6.18	3.16	3.83	3.76	6.2.E+01	1.2.E+01	9.7.E+02	7.4.E+01	1.3.E+03	8.6.E+01	1.1.E+03	6.6.E+01	3.8.E+02	0.1	5.0.E+03	1.0	7.9.E+03	1.4	9.3.E+03	2.8	
	4.0-4.5	294	234	353	236	6.84	3.68	4.62	4.29	8.8.E+01	1.4.E+01	7.5.E+02	4.9.E+01	4.4.E+02	3.5.E+01	7.7.E+02	5.2.E+01	5.8.E+02	0.1	3.9.E+03	0.8	3.4.E+03	0.6	4.1.E+03	1.2	
	4.5-5.0	323	338	267	340	7.56	4.43	5.21	5.05	1.6.E+02	2.0.E+01	4.2.E+02	3.1.E+01	7.1.E+02	2.6.E+01	5.0.E+02	3.2.E+01	1.2.E+03	0.2	3.1.E+03	0.7	4.2.E+03	0.7	3.8.E+03	1.1	
	5.0-6.0	582	495	717	664	8.85	5.53	6.80	6.52	6.1.E+01	1.1.E+01	4.9.E+02	2.2.E+01	1.4.E+02	9.3.E+00	4.6.E+02	3.3.E+01	7.9.E+02	0.1	5.4.E+03	1.1	2.2.E+03	0.4	6.8.E+03	2.1	
	6.0-7.0	623	624	762	596	10.24	6.92	8.50	7.85	4.2.E+01	9.7.E+00	3.3.E+02	2.3.E+01	1.5.E+02	7.9.E+00	3.4.E+02	2.4.E+01	5.8.E+02	0.1	4.5.E+03	0.9	2.5.E+03	0.4	4.5.E+03	1.4	
	7.0-8.0	580	541	578	575	11.53	8.13	9.78	9.13	6.3.E+01	1.1.E+01	1.4.E+02	1.1.E+01	8.9.E+01	5.2.E+00	3.5.E+02	1.8.E+01	8.1.E+02	0.1	1.7.E+03</						

Total (without litter)	6192	3901	4596	3718
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- a: weight per unit volume (225 or 450 cm³) of soil samples collected using scraper plate after oven heating.
- b: caluculated from depth (cm) and bulk density (g cm⁻³).
- c: one sample in U8 container was measured for each layer.
- d: standard deviation from counting statistics of sample mesurement.
- e: caluculated from mass per unit area and concentration for each layer.